File D 52.338/31 *McCOOK FIELD REPORT, SERIAL No. 1769*

AIR SERVICE INFORMATION CIRCULAR

(AVIATION)

PUBLISHED BY THE CHIEF OF AIR SERVICE, WASHINGTON, D. C.

Vol. IV March 15, 1922 No. 328

REPORT OF WIND TUNNEL TESTS ON AEROFOILS: DAYTON-WRIGHT NOS. TT-1 AND TT-2, DAYTON-WRIGHT NOS. 5 AND 6, AND GOTTINGEN NO. 387

(AIRPLANE SECTION, S. & A. BRANCH)

Prepared by Engineering Division, Air Service
McCook Field, Dayton, Ohio
October 24, 1921

WASHINGTON
GOVERNMENT PRINTING OFFICE
1922

CERTIFICATE: By direction of the Secretary of War, the matter contained herein is published as administrative information and is required for the proper transaction of the public business.

REPORT OF WIND TUNNEL TESTS ON AEROFOILS: DAYTON-WRIGHT NOS. TT-1 AND TT-2, DAYTON-WRIGHT NOS. 5 AND 6, AND GOTTINGEN NO. 387.

OBJECT OF TESTS.

The above aerofoils were tested at Massachusetts Institute of Technology during June and August, 1921, to determine lift, drag, L/D, center of pressure, and moments about the leading edge.

DESCRIPTION OF MODELS.

The Dayton-Wright Nos. 5 and 6 and the Gottingen No. 387 were constructed of wood by the Dayton-Wright Co. Their dimensions are 18 by 3 inches.

The Dayton-Wright aerofoils Nos. TT-1 and TT-2 have the same ordinates as the DW-3 and DW-4, respectively, but have a split trailing edge. Instead of a true flap wing the lower part of the trailing edge up to the rear spar is hinged and adjustable, while the upper part of the trailing edge remains rigid. The flap chord in each case is 30 per cent of the wing chord. These two variable camber sections have a span of 17.453 inches and a mean geometrical chord of 3.0356 inches, and were constructed of bakelite by the Dayton-Wright Co. They are tapered and the center line of the flap hinges is at right angles to the chord line. In testing these models, however, an actual flap was not used. On the lower trailing edge, triangular sections were built up in such a manner that the face of the sections made successive angles of 15°, 30°, and 45° to the wing chord.

RESULTS.

These sections are compared with the R. A. F. 15 and the U. S. A. 27. Figure 1 gives a comparison of the profiles of a number of sections.

The Dayton-Wright No. 5 has a maximum lift coefficient of 0.00265 compared to 0.00258 for the R. A. F. 15, 0.00365 for the U. S. A. 27, 0.00398 for the D. W. No. 6, 0.00307 for the D. W. TT-1, 0.00318 for the D. W. TT-2, the two latter values with the flap at 0°, and 0.00415 for the Gottingen No. 387. The lift coefficient for the TT-1 and TT-2 increases very rapidly for increasing angle of flap to chord. The maximum Ky for TT-1 with flaps at 45° being 0.00485 and for the TT-2 with flap at 45° being 0.00499. The D. W. No. 5 is better than the D. W. TT-1 or TT-2 for stability, but less stable than the R. A. F. 15 or the U. S. A. 27.

The maximum L/D for the D. W. No. 5 is 16.6, which is higher than the maximum L/D for any of the other sections, the L/D for the D. W. No. 6 being 13.63, 14.8 for the TT-1 with flap at 0°, 15.22 for the TT-2 with flap at 0°, 13.5 for the Gottingen 387, 16 for the U. S. A. 27 and 16.3 for R. A. F. 15.

The maximum L/D for the TT-1 and TT-2 falls very rapidly with increasing angle of the flap to the wing chord. Maximum L/D for the TT-1 with flap at 45° is 4.4 and for the TT-2 with flap at the same angle is 4.5. The minimum drag coefficient of the two sections increases very rapidly with increasing angle of the flap to the chord.

The criterion of high speed for pursuit airplane is the L/D taken at 1/9 maximum Ky. The L/D at this Ky for the D. W. No. 5 is 6.5 as compared with 4.5 for the Gottingen No. 387, 5.4 for the D. W. No. 6, a maximum of 5.65 for the D. W. TT-1, a maximum of 6.2 for the D. W. TT-2, 7.7 for the R. A. F. 15, and 4.6 for the U. S. A. 27. The D. W. No. 5 will therefore have a higher speed than any of the others except the R. A. F. 15. The L/D at this Ky falls very rapidly for the TT-1 and TT-2 as the flap angle is increased. For the TT-1 it is only 1 at 45° and 1.3 for the TT-2.

The criterion of high speed for reconnaissance airplanes is the L/D at $\frac{\text{Ky maximum}}{6.25}$. At this value of Ky the L/D for the D. W. No. 5 is 9.3 as compared to 7.85 for the D. W. No. 6, a maximum of 8.10 for the D. W. TT-1, a maximum of 8.9 for the D. W. TT-2, 6.75 for the Gottingen No. 387, 9.7 for the R. A. F. 15 and 7 for the U. S. A. 27. The D. W. No. 5 has a higher value of L/D than any of the others except the R. A. F. 15 at this Ky.

The criterion of high speed for large airplanes is the L/D at 1/4 maximum Ky. The L/D for the D. W. No. 5 at 1/4 maximum Ky is 12.85, as compared to 13.5 for R. A. F. 15, 11.7 for the U. S. A. 27, 10.45 for Gottingen No. 387, 11.4 for the D. W. No. 6, a maximum of 12.60 for the D. W. TT-1, and a maximum of 12.7 for the D. W. TT-2.

The speed range is expressed by the formula:

$$\frac{\sqrt{\text{Ky maximum}}}{\sqrt{\text{Kx minimum}}}$$

The speed range of the Dayton-Wright No. 5 is 1.446, for the R. A. F. 15 it is 1.494, for the U. S. A. 27 it is 1.410, for the Gottingen No. 387 it is 1.410, for the D. W. No. 6 it is 1.446, for the D. W. TT-1 it is a maximum at 1.488, and for the TT-2 it is a maximum at 1.445. The D. W. TT-1 has a larger speed range than any of the other aerofoils except the R. A. F. 15. The speed range for the D. W. TT-1 and TT-2 decreases rapidly with increase of angle of flap.

The ceiling and climb for constant loading is expressed by the maximum value of $Ky^{3/2}/Kx$. The value for the U. S. A. 27 is 0.665, for the R. A. F. 15 is 0.615, for the Gottingen No. 387, 0.623; for the D. W. No. 5, 0.629; for the D. W. No. 6, 0.604; a maximum of 0.610 for the D. W.

TT–1 and a maximum of 0.638 for the D. W. TT–2. The D. W. TT–2 is second only to the U. S. A. 27 for ceiling and climb. The ceiling and climb, however, drop off rapidly for the D. W. TT–1 and TT–2 with increase of flap angle.

The ceiling and climb with constant landing speed is determined from the minimum value of the expression

$$\sqrt{\frac{\text{Ky maximum}}{\frac{\text{Ky}}{\text{L/D}}}}$$

The L/D corresponds to the Ky to be used.

The value for the Gottingen No. 387 is 0.1035, for the D. W. No. 5, 0.0818; for the D. W. No. 6, 0.1045; for the R. A. F. 15, 0.0827; for the U. S. A. 27, 0.0908; for the D. W. TT–1 with flap at 0°, 0.0912 and for the D. W. TT–2 with flap at 0°, 0.0877. For increasing flap angles for these two variable sections this value decreases, the value with the flap at 45° for the TT–1 being 0.2360 and for the TT–2 at the same angle being 0.2310.

For the D. W. No. 5 and R. A. F. 15 the maximum forward position of the center of pressure is at 29 per cent of the chord, for the Gottingen No. 387 it is 32 per cent, for the D. W. No. 6 it is 30.3 per cent, for the D. W. TT–1 it is 35.1 per cent with flap at 0°, for the D. W. TT–2 it is 35.8 per cent with flap at 0°, and for the U. S. A. 27 it is 27.4 per cent. For the variable sections, D. W. TT–1 and TT–2, the maximum forward position has a maximum variation of about 10 per cent of the chord in each case with the flaps set at various angles from 0° to 45°, inclusive.

The center of pressure travel is figured between the most forward position and the position at the angle of Ky maximum/6.25. The values for the center of pressure travel are shown in Table I.

For comparison in diving, the moment coefficient with respect to the leading edge for the angle of zero lift is used.

$$\text{The moment coefficient} = \frac{M}{\rho A\, V^2 c} = \sqrt{Ky^2 + Kx^2} \times (Kc.p.)$$

Where M is the moment in inch-pounds about the leading edge.

A = area of aerofoil.
V = velocity of wind.
c = chord.
$Kc.p.$ = center of pressure coefficient.
Ky = lift coefficient.
Kx = drag coefficient.

The spar depths for the above-mentioned sections are also shown in Table I. All of the Dayton-Wright sections and the Gottingen No. 387 have sufficient spar depth for use as internally braced wings, except the Dayton-Wright No. 5.

DISCUSSION.

A comparison of the tests run at Gottingen and at Massachusetts Institute of Technology on the Gottingen No. 387 shows a considerable difference in results.

This difference is attributed to the fact that the section constructed in this country was built from the ordinates scaled by the N. A. C. A. off of a silhouette published in the Technische Berichte, and also due to the Gottingen test being run with a wind velocity of 67 miles per hour. The German model varied slightly from the Dayton-Wright at three points.

The Gottingen No. 387 has a very high left coefficient, but its aerodynamical efficiency is very much inferior to the U. S. A. 27. Its high-speed characteristic, however, is but slightly less than the U. S. A. 27, and its speed range is the same. The ceiling and climb for constant loading and constant landing speed are very poor as compared to the U. S. A. 27. Its maximum forward position of the center of pressure and the center of pressure travel are slightly inferior to the U. S. A. 27, but its spar depths are considerably superior to this section. It would seem that the Gottingen No. 387 would find its greatest use on a high-speed reconnaissance airplane, where speed and maneuverability are very desirable and where ceiling and high climbing rate are not so essential. It is handicapped, however, by a rather low cruising radius as determined by its maximum L/D, and by its instability at high angles of incidence.

The Dayton-Wright No. 5 compares very favorably throughout with the R. A. F. 15. Its maximum lift coefficient, efficiency, and cruising range are somewhat better, but its maximum speed and speed range are considerably less. It, however, has a superior ceiling and climb for constant loading and constant landing speed. The maximum forward position of the center of pressure is the same, while its center of pressure travel is 21 per cent as compared to 14 per cent for the R. A. F. 15. The D.W. No. 5 also has better spar depths than the English section. It has a very high speed for use on either high-speed reconnaissance or large bombers, but its spar depths are not great enough for extensive use on these types. Its greatest use should be in pursuit types.

The Dayton-Wright No. 6 falls into about the same class as the Gottingen No. 387. It has a slightly inferior maximum lift coefficient, a little better speed for all types of airplanes, a much superior speed range, but the poorest ceiling and climb for constant loading and constant landing speed of any section shown in Table I. Its maximum forward position of center of pressure and the center of pressure travel are reasonable, being 30.3 and 32.2 per cent, respectively. This section, like the Gottingen No. 387, is very unstable after the burble point is reached. It possesses very deep wing spars, better than the U. S. A. 27 and but slightly inferior to the Gottingen No. 387. The front and rear spars are almost of equal depth.

The two Dayton-Wright aerofoils Nos. TT–1 and TT–2 were not tested as sections with true flaps, but built up along the trailing edge as described above. It is not known just what effect this will have on the characteristics over that of the true flap section.

The Dayton-Wright No. TT–1 tested with adjustable surface at 0° possesses very good characteristics throughout. It has a high lift coefficient, good cruising and high-speed characteristics for all types of airplanes. Its speed range is very high, although the ceiling and climb for constant loading is very poor and for constant landing speed is just average. The maximum forward position of the center of pressure is rather far back, although the center of pressure travel is rather small, being 22.9 per cent. This section possesses spar depths much greater than the U. S. A. 27, making it a good section for the internally

braced wing type. This aerofoil would be a very good section for a high-speed, heavily loaded airplane, either a bomber or heavy duty commercial airplane.

The Dayton-Wright No. TT-2 possesses slightly better characteristics throughout, except for speed range and maximum forward position of the center of pressure, than the Dayton-Wright No. TT-1.

As the angle of the flap is increased on these two sections the lift increases very rapidly to the detriment of all other characteristics except the landing speed. The efficiency falls very rapidly. On both the D. W. TT-1 and TT-2 the center of pressure travel taken at the angle of Ky maximum/6.25 moves toward the trailing edge very rapidly as the flap angle is increased. However, to reach the angle of Ky maximum/6.25 with increase of flap angle creates a condition of flight where the angle of attack is far below the normal high-speed angle. Therefore, one of the advantages of the trailing edge flap is that it may be used to throw the center of pressure forward on the wing at high speeds by increasing the flap angle. It is observed that on the D. W. TT-1 the center of pressure location, with flap at 0° and at an angle of attack of −1° is 61 per cent back of the leading edge. If the angle of attack is held constant and the flap angle increased through the range of 45°, the center of pressure position may be moved forward until it is at 48.5 per cent of the wing chord. The center of pressure travel on the D. W. TT-2 at an angle of attack of −1° may, by operation of the flaps, be moved forward from a position at 60 per cent to a point about 48.5 per cent back on the wing chord. It is seen, therefore, that the adjustable flap may be used as a powerful control over the position of the center of pressure under high-speed conditions. This control of the center of pressure position is rather ineffective at climbing or landing speeds. At landing speeds the flaps play a very important rôle, in that they may be used to create a very high lift at very low speeds, or, in other words, they extend the speed range.

A comparison of these two sections with the Glenn Martin No. 2-F gives the following results: The maximum lift coefficient of the M-2-F with both leading and trailing edge flaps at 0° is given as 0.004 as compared to 0.00307 for the TT-1 and 0.00318 for the TT-2. There is considerable doubt as to the value of the very high lift coefficients obtained for very thick wing sections such as the M-2-F. Several tests were made on the M-2-F and it seems that in the neighborhood of 14° incidence the section may become unstable with the least unsteadiness of the wind or if there exists a slight flat spot on the model. One test gave a maximum Ky of 0.0033, and another gave 0.00358. The maximum lift coefficient of the M-2-F with the rear flap at 40° and the front flap at 0° is 0.00507, and with the rear flap at 50° is about 0.00480 as compared to 0.00482 for the TT-1 and 0.00499 for the TT-2, both sections with flaps at 45°.

The maximum L/D for the M-2-F with both flaps at 0° is 14.12 as compared to 14.8 for the TT-1 and 15.22 for the TT-2. The L/D at 8° incidence and with rear flap at 45° for the M-2-F is about 4.25 and for the TT-2 it is 3.2.

Figures 17 and 18 are the envelope curves of the Dayton-Wright Nos. TT-1 and TT-2 for L/D versus lift coefficient. The shaded area represents the increase for the various flap settings.

Table I.—*Comparative table of following aerofoil sections.*

Aerofoil.	R. A. F. 15.	U. S. A. 27.	Gottingen No. 387.	Dayton-Wright.									
				No. 5.	No. 6.	No. TT-1.				No. TT-2.			
						0°	15°	30°	45°	0°	15°	30°	45°
Maximum Ky (landing)	0. 00258	0. 00363	0. 00415	0. 00265	0. 00398	0. 00307	0. 00394	0. 00454	0. 00485	0. 00318	0. 00406	0. 00456	0. 00499
Minimum Kx	. 0000393	. 000073	. 000098	. 00005	. 000083	. 000052	. 00014	. 000295	. 00050	. 00006	. 000152	. 000275	....
Maximum L/D (cruising)	16. 3	16. 0	13. 5	16. 6	13. 63	14. 8	10. 1	6. 5	4. 4	15. 22	8. 9	6. 85	4. 5
High speed, pursuit, L/D at 1/9 maximum Ky	7. 7	4. 6	4. 5	6. 5	5. 4	5. 65	3. 1	1. 65	1. 00	6. 2	2. 95	1. 4	1. 3
High speed reconnaissance fighter, L/D at 1/6.25 maximum Ky	9. 7	7. 0	6. 75	9. 3	7. 85	8. 10	4. 2	2. 45	1. 45	8. 9	3. 95	2. 1	1. 57
High speed, bomber, L/D at 1/4 maximum Ky	13. 5	11. 7	10. 45	12. 85	11. 4	12. 60	6. 15	3. 78	1. 95	12. 7	5. 75	4. 3	2. 15
Speed range $\frac{\sqrt{Ky\ max.}}{\sqrt{Kx\ min.}}$	1. 494	1. 410	1. 410	1. 395	1. 446	1. 488	1. 215	1. 036	. 88	1. 445	1. 24	1. 04	....
Ceiling and climb const. loading $\frac{Ky^{3/2}}{Kx}$ maximum	. 615	. 665	. 623	. 629	. 604	. 610	. 542	. 415	. 305	. 638	. 528	. 746	. 307
Const. landing speed $\frac{\sqrt{Ky\ max.}}{\frac{Ky}{L/D}}$ minimum	. 0827	. 0908	. 1035	. 0818	. 1045	. 0912	. 1168	. 1620	. 2360	. 0877	. 1245	. 1561	. 2310
Maximum forward position of C. P. (in case of tapered wings state what chord used)	29. 0	27. 4	32. 0	29. 0	30. 3	35. 1	40. 4	43. 0	42. 7	35. 8	40. 8	42. 5	44. 0
C. P. travel in per cent chord between maximum forward position and position at angle of Ky maximum /6.25	14. 0	39. 6	41. 0	21. 0	32. 2	22. 9	46. 6	48. 0	[1] 62. 3	19. 8	43. 2	41. 0	25. 5
Spar depths per cent of chord:													
10 per cent from leading edge	6. 05	9. 2	12. 07	6. 68	10. 833	10. 7484	....	....	....	13. 530	....	....	....
15 per cent from leading edge	6. 31	10. 4	13. 83	7. 11	12. 377	12. 542	....	....	....	15. 330	....	....	....
60 per cent from leading edge	5. 30	9. 2	11. 05	5. 80	10. 583	10. 778	....	....	....	11. 820	....	....	....
70 per cent from leading edge	4. 80	7. 9	8. 62	5. 09	8. 783	8. 9032	....	....	....	9. 330	....	....	....
Authority	M. I. T.	M. I. T.	M. I. T.	M. I. T.	M. I. T.	M. I. T.				M. I. T.			
Date test run	June, 1919	Nov., 1920	Aug., 1921	Aug., 1921	Aug., 1921	June, 1921				June, 1921			
Velocity of wind (m. p. h.)	30	30	30	30	30	30				30			
Aspect ratio	6	6	6	6	6	5. 76				5. 76			
McCook Field serial number	....	1460	....	....	....								

[1] Center of pressure at angle for Ky maximum /6.25 of chord.

TABLE II.—*Gottingen No. 387.*

Authority: Aerodynamical Laboratory, Massachusetts Institute of Technology, August, 1921.
Velocity: 30 miles per hour.
Model: 18 by 3 inches wood.

α	Ky.	Kx.	L/D.	M_{le}	C. P.
−10	−0.000295	0.000275	−1.07	−0.040	....
−8	−.000015	.000182	−.084	−.205	....
−6	+.000380	.000115	+3.31	−.385	....
−4	.000750	.000098	7.65	−.500	0.660
−2	.001150	.000102	11.30	−.572	.492
0	.001545	.000118	13.10	−.675	.429
+2	.001945	.000145	13.40	−.775	.393
4	.00233	.000182	12.75	−.877	.368
6	.00271	.000225	12.00	−.975	.350
8	.003075	.000275	11.15	−1.068	.339
10	.00341	.000330	10.30	−1.153	.331
12	.00371	.000390	9.52	−1.230	.328
14	.00398	.000450	8.85	−1.298	.324
16	.00415	.000515	8.06	−1.328	.320
18	.00237	.000858	2.76	−.988	.391
20	.00223	.000950	2.34	−.990	.402
22	.00221	.001045	2.11	−1.008	.410
24	.00224	.001145	1.955	−1.032	.410

M_{le}=moment about leading edge in inch pounds at 30 miles per hour

TABLE III.—*Dayton-Wright No. 5.*

Authority: Aerodynamical Laboratory, Massachusetts Institute of Technology, August, 1921.
Velocity: 30 miles per hour.
Model: 18 by 3 inches wood.

α	Ky.	Kx.	L/D.	M_{le}	C. P.
−4	−0.00024	0.000062	−3.86	−0.019	....
−2	+.00014	.000053	+2.67	−.112	0.777
0	+.00072	.000052	+13.73	−.297	.407
+2	+.00115	.000069	16.54	−.401	.347
4	.00153	.000095	16.02	−.493	.317
6	.00189	.000131	14.41	−.585	.303
8	.00227	.000172	13.20	−.690	.297
10	.00261	.000221	11.84	−.768	.290
12	.00263	.000376	6.99	−.828	.307
14	.00243	.000562	4.33	−.878	.347
16	.00229	.000696	3.29	−.917	.377
18	.00224	.000792	2.83	−.934	.387
22	.00220	.000983	2.23	−.947	.387
26	.00225	.001182	1.91	−1.013	.390
30	.00236	.001469	1.61	−1.129	.400

M_{le}=moment about leading edge in inch pounds at 30 miles per hour.

TABLE IV.—*Dayton-Wright No. 6.*

Authority: Aerodynamical Laboratory, Massachusetts Institute of Technology, August, 1921.
Velocity: 30 miles per hour.
Model: 18 by 3 inches wood.

α	Ky.	Kx.	L/D.	M_{le}	C. P.
−8	−0.00035	0.000178	−1.97	....	....
−6	+.00014	.000104	+1.37	−0.287	....
−4	+.00056	.000082	6.76	−.392	0.700
−2	.00090	.000085	10.63	−.464	.507
0	.00134	.000098	13.58	−.584	.430
+2	.00168	.000124	13.54	−.664	.387
4	.00207	.000160	12.93	−.756	.360
6	.00245	.000201	12.20	−.859	.343
8	.00279	.000247	11.31	−.940	.330
10	.00313	.000302	10.36	−1.032	.323
12	.00342	.000353	9.69	−1.105	.317
14	.00369	.000412	8.96	−1.161	.310
16	.00394	.000464	8.49	−1.219	.307
18	.00397	.000544	7.31	−1.223	.303
22	.00230	.000996	2.31	−.974	.380
26	.00218	.001189	1.83	−.975	.387
30	.00224	.001433	1.56	−1.071	.397

M_{le}=moment about leading edge in inch pounds at 30 miles per hour.

Table V.—*Dayton-Wright No. TT-1.*

Authority: Aerodynamical Laboratory, Massachusetts Institute of Technology, June, 1921.
Velocity: 30 miles per hour.
Model: 17.453 by 3.777 inches bakelite.

α	Ky.				Kx.				L/D.				Moment coefficient.				Center of pressure.			
	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°
−16	...	...	...	−0.001	...	...	...	0.000565	...	...	...	−1.80	...	...	...	...	...	...	...	...
14	...	...	...	−.00057	...	...	...	.000502	...	...	...	−1.10	...	...	...	...	...	...	...	...
12	...	...	−0.00094	+.00045	...	...	0.000385	.000542	...	...	−2.48	+.90	...	...	...	−0.00636	...	...	...	...
10	...	...	−.00013	.00164	...	0.000305	.000330	.000632	...	−5.0	−.35	2.57	...	...	−0.00636	−.01200	...	...	...	68.0
8	...	−0.00038	+.00083	.00208	0.000235	.000185	.000300	.000680	−4.72	−1.9	+2.74	3.08	...	−0.00216	−.00864	−.01440	...	...	87.0	57.6
6	−0.00072	+.00038	.00139	.00243	.000140	.000140	.000310	.000710	−4.48	+2.8	4.45	3.42	...	−.00504	−.01056	−.01548	...	...	66.0	53.0
4	−.00031	.00090	.00180	.00275	.000080	.000150	.000345	.000740	−3.84	5.7	5.36	3.70	...	−.00720	−.01224	−.01644	...	72.0	57.8	49.8
2	+.00015	.00130	.00217	.00310	.000055	.000165	.000380	.000784	+2.65	8.0	5.78	3.98	−0.00180	−.00888	−.01398	−.01788	100.0	56.5	53.0	47.8
0	.00071	.00172	.00261	.00340	.000060	.000185	.000425	.000835	11.50	9.5	6.15	4.16	−.00432	−.01056	−.01548	−.01937	50.5	49.8	49.8	46.1
+2	.00113	.00216	.00303	.00385	.000075	.000215	.000470	.000900	14.72	10.08	6.40	4.30	−.00588	−.01212	−.01710	−.02076	43.5	47.0	47.8	45.0
4	.00151	.00257	.00342	.00422	.000105	.000255	.000530	.000960	14.62	10.02	6.50	4.38	−.00720	−.01380	−.01888	−.02208	40.0	44.8	46.0	44.0
6	.00188	.00300	.00382	.00452	.000135	.000310	.000590	.001035	13.85	9.72	6.50	4.38	−.00840	−.01548	−.02070	−.02340	38.0	43.0	44.8	43.0
8	.00228	.00337	.00421	.00482	.000180	.000365	.000655	.001120	12.75	9.25	6.40	4.24	−.00960	−.01704	−.02220	−.02448	36.8	41.6	44.0	42.5
10	.00263	.00375	.00449	.00482	.000230	.000432	.000735	.001270	11.55	8.64	6.12	3.75	−.01129	−.01836	−.02310	−.02502	36.0	40.6	43.0	43.1
12	.00295	.00392	.00453	.00443	.000285	.000510	.000900	.001550	10.35	7.18	5.10	2.85	−.01260	−.01900	−.02340	−.02400	35.5	40.7	43.0	45.0
14	.00307	.00388	.00432	.00367	.000360	.000710	.001150	.001720	8.50	5.30	3.60	2.12	−.01308	−.01920	−.02334	−.02040	35.8	41.6	45.3	46.5
16	.00287	.00355	.00382	.00346	.000560	.000955	.001340	.001860	4.90	3.70	2.80	1.85	−.01368	−.01885	−.02148	−.01968	39.6	44.0	47.0	47.5
18	.00269	.00327	.00345	.00323	.000750	.001120	.001455	.002020	3.57	3.00	2.34	1.65	−.01356	−.01812	−.01956	−.01878	42.3	46.0	47.0	48.0
20	.00252	.00303	.00318	.00303	.000875	.001240	.001555	.002220	2.88	2.42	2.02	1.42	−.01320	−.01716	−.01800	−.01752	43.8	47.0	47.0	48.6
22	.00236	.00282	.00299	.00283	.000965	.001335	.001640	...	2.40	2.00	...	...	−.01249	−.01620	−.01686	...	44.2	47.8	46.8	...
24	.00220	...	.00287	.00266	.001500	.001390	.001735	...	2.10	1.62	...	...	−.01163	−.01536	−.01608	...	44.0	48.0	46.5	...

Table VI.—*Dayton-Wright No. TT-2.*

Authority: Aerodynamical Laboratory, Massachusetts Institute of Technology, June, 1921.
Velocity: 30 miles per hour.
Model: 17.453 by 3.777 inches bakelite.

α	Ky.				Kx.				L/D.				Moment coefficient.				Center of pressure.			
	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°	0°	15°	30°	45°
−16	...	...	...	−0.00012	...	...	...	0.000500	...	...	...	−0.3	...	...	...	...	...	...	...	...
−14	...	...	...	+.00075	...	...	...	.000555	...	...	...	+1.50	...	...	...	...	...	...	...	76.5
−12	...	...	−0.00058	.00180	...	...	0.000345	.000620	...	...	−1.65	2.86	...	...	...	...	...	...	...	65.0
−10	...	−0.00086	+.00012	.00226	...	0.000285	.000285	.000660	...	−3.0	−1.25	3.40	...	...	...	...	...	...	...	59.0
−8	...	−.00019	.00101	.00263	...	.000195	.000275	.000700	...	−1.25	+3.75	3.74	...	...	−0.00901	−0.01700	...	...	75.0	54.8
−6	...	+.00047	.00141	.00299	...	.000155	.000298	.000760	...	+3.10	5.18	4.00	...	−0.00564	−.01072	−.01870	...	99.0	62.5	51.8
−4	−0.00019	.00094	.00193	.00316	0.000070	.000161	.000332	.000815	−2.65	5.45	5.80	4.14	...	−.00760	−.01318	−.02500	...	68.0	55.8	49.8
−2	+.00025	.00138	.00234	.00373	.000060	.000182	.000372	.000865	+4.50	7.55	6.24	4.35	−0.002638	−.00953	−.01477	−.02218	85.5	55.8	51.2	48.0
0	.00069	.00182	.00276	.00409	.000062	.000210	.000425	.000900	11.25	8.74	6.55	4.46	−.004240	−.01144	−.01665	−.02359	49.5	50.7	48.5	46.5
+2	.00113	.00222	.00315	.00445	.000075	.000248	.000472	.000985	14.75	9.00	6.72	4.50	−.006200	−.01310	−.01830	−.02510	44.0	47.4	46.5	45.0
4	.00152	.00264	.00357	.00479	.000100	.000290	.000520	.001075	15.00	9.10	6.82	4.44	−.007820	−.01485	−.02008	−.02665	41.0	45.2	45.0	44.3
6	.00193	.00304	.00398	.00499	.000135	.000335	.000580	.001205	14.15	9.00	6.82	4.10	−.009380	−.01658	−.02200	−.02780	39.0	43.7	44.0	44.0
8	.00232	.00344	.00418	.00459	.000175	.000395	.000655	.001435	13.25	8.65	6.68	3.18	−.010860	−.01810	−.02336	−.02755	37.8	42.2	43.2	46.7
10	.00270	.00382	.00456	.00390	.000222	.000462	.000755	.001620	12.15	8.30	6.05	2.45	−.01220	−.01953	−.02440	−.02550	36.15	41.0	42.5	49.5
12	.00299	.00406	.00412	.00362	.000280	.000492	.001025	.001775	10.65	7.50	4.00	2.05	−.01332	−.02065	−.02400	−.02440	35.9	41.0	45.6	50.5
14	.00318	.00374	.00366	.00352	.000348	.000830	.001210	.001915	9.10	4.50	3.00	1.80	−.01420	−.02080	−.02260	−.02440	36.0	43.8	48.0	50.8
16	.00305	.00332	.00332	.00341	.000600	.000990	.001350	.002040	4.75	3.35	2.45	1.65	−.01530	−.02000	−.02140	−.02436	39.8	46.6	48.5	51.0
18	.00253	.00302	.00307	.00320	.000765	.001125	.001455	.002155	3.05	2.70	2.10	1.50	−.01440	−.01910	−.02056	...	43.8	47.9	49.0	...
20	.00225	.00280	.00299	.00290	.000872	.001240	.001550	.002250	2.45	2.28	...	1.35	−.01336	−.01850	...	...	44.7	48.5	49.0	...
22	.00216	.00269	...	...	.000936	.001325	...	...	2.20	2.00	...	...	...	...	...	...	45.0	48.8	...	...
24	.00213	.00262	...	...	.000975	.001400	...	...	2.10	...	...	...	...	...	...	...	45.0	48.8	...	...

TABLE VII.—*Ordinates of the Gottingen No. 387, Dayton-Wright Nos. 5, 6, TT-1 and TT-2, expressed in per cent of chord.*

Per cent of chord.	Gottingen No. 387.		Dayton-Wright.							
			No. 5.		No. 6.		No. TT-1.		No. TT-2.	
	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.	Lower.	Upper.
0.00	3.61	3.61	1.83	1.83	3.083	3.083	0.0000	0.0000	0.00	0.00
1.25	1.35	6.74	.90	3.47	1.266	5.216	−1.5097	2.1303		3.00
2.50	.80	7.98	.47	4.30	.833	6.467	−1.7806	3.4000	−3.50	4.30
5.00	.35	9.86	.08	5.43	.333	8.383	−2.2000	5.3032	−4.23	6.13
7.50	.18	11.20	.00	6.20	.133	9.783	−2.5290	6.8645	−4.71	7.45
10.00	.13	12.20	.05	6.73	.050	10.883	−2.8000	7.9484	−5.00	8.53
11.56					.000	11.466				
15.00	.00	13.83	.25	7.36	.073	12.450	−3.1612	9.3807	−5.18	10.15
20.00	.07	14.77	.50	7.63	.167	13.400	−3.3290	10.2774	−5.00	11.28
30.00	.21	15.36	.90	7.73	.367	13.967	−3.1613	11.0194	−4.40	12.28
40.00	.37	14.88	.90	7.43	.450	13.500	−2.7290	10.7225	−3.80	12.05
50.00	.54	13.49	.68	6.90	.300	12.300	−2.2613	10.0194	−3.20	10.96
60.00	.54	11.59	.33	6.13	.150	10.733	−1.9006	8.8774	−2.56	9.26
70.00	.54	9.16	.07	5.16	.033	8.816	−1.5290	7.3742	−2.03	7.30
75.00					.000	7.667				
80.00	.49	6.57	.00	4.06	.033	6.367	−1.1606	5.4774	−1.38	5.06
90.00	.27	3.61	.20	2.75	.117	3.767	− .7000	3.1161	− .78	2.68
95.00			.35	1.85	.200	2.300	− .4600	1.7774		
100.00	.00	.36	.75	.75	.567	.000	.0000	.0000	.00	.00

Gottingen No. 387, radius L. E.=3.25, T. E.=0.20.
Dayton-Wright No. 5, radius L. E.=0.40, T. E.=0.15.
Dayton-Wright No. 6, radius L. E.=1.73, T. E.=0.20.
Dayton-Wright No. TT-1, radius L. E.=1.6161, T. E.=0.2761.
Dayton-Wright No. TT-2, radius L. E.=3.70, T. E.=0.133.

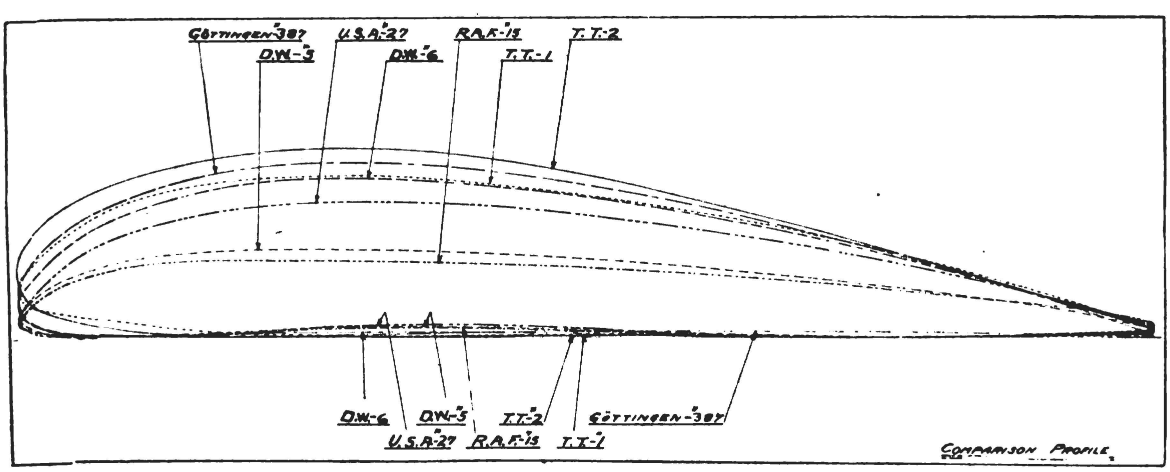


FIG. 1.

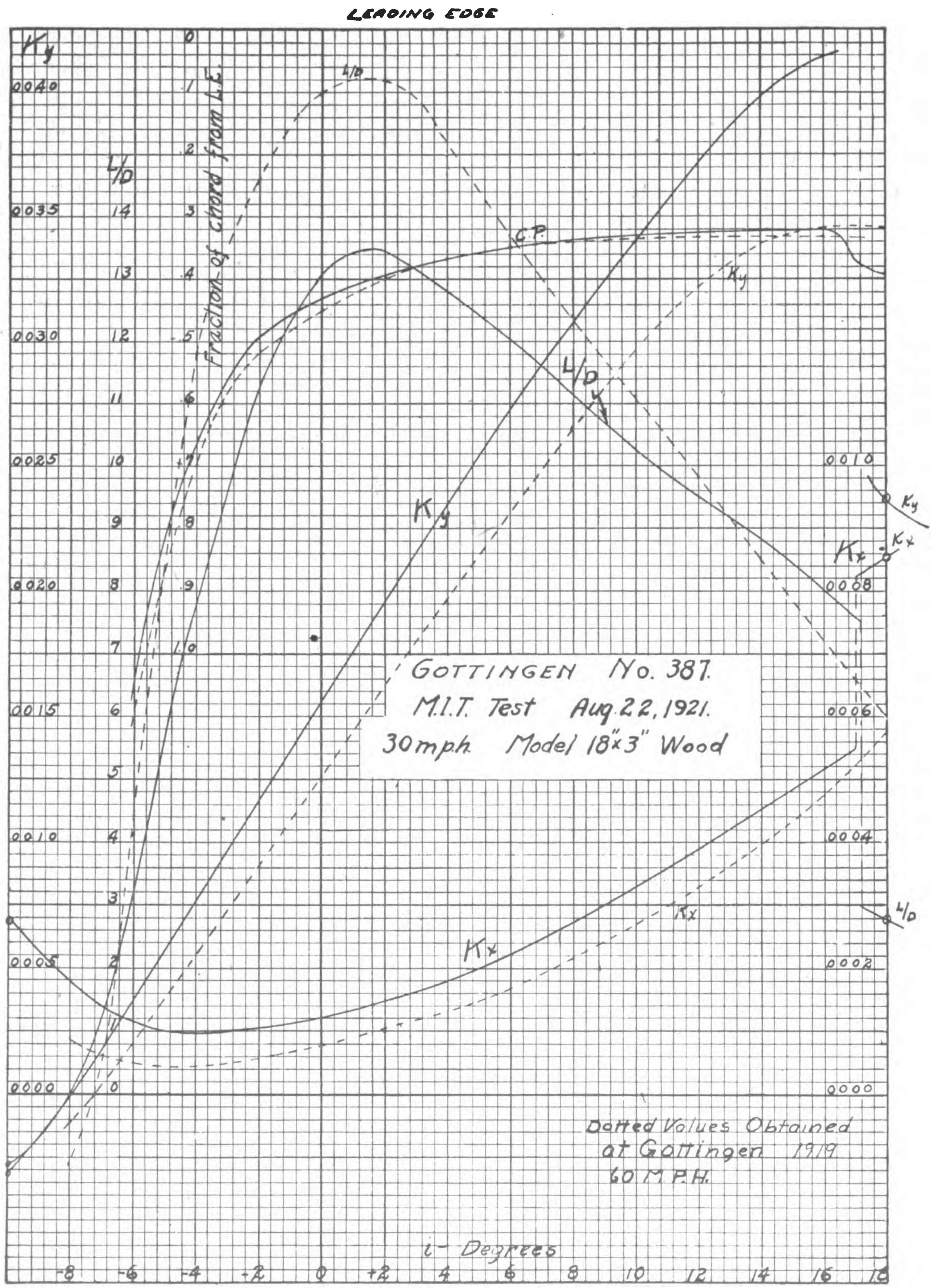

LEADING EDGE
Ky
L/D
Fraction of chord from L.E.
C.P.
Ky
L/D
Kx
Gottingen No. 387.
M.I.T. Test Aug. 22, 1921.
30 mph. Model 18"×3" Wood
Dotted Values Obtained
at Gottingen 1919
60 M.P.H.
i - Degrees

FIG. 2.

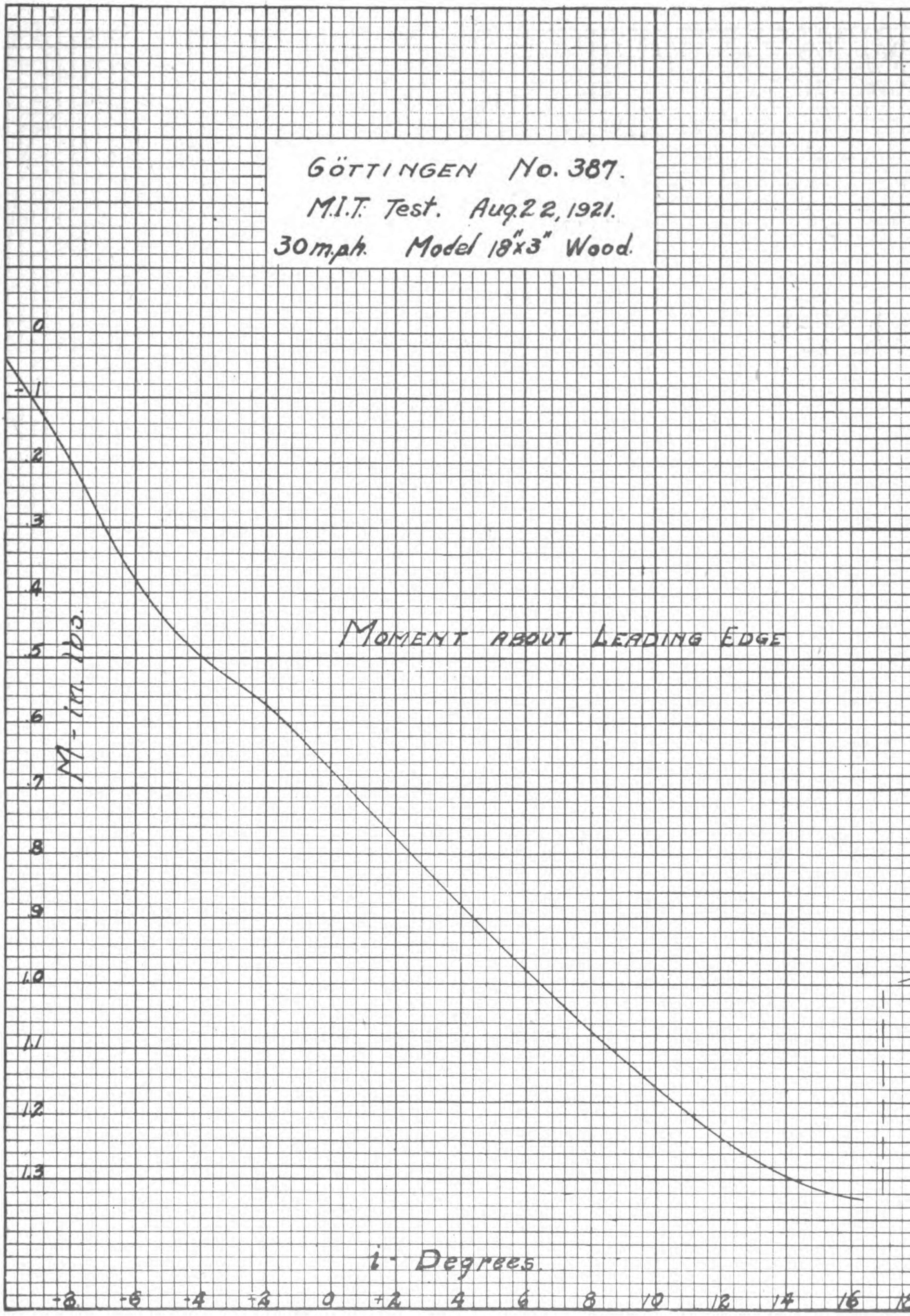
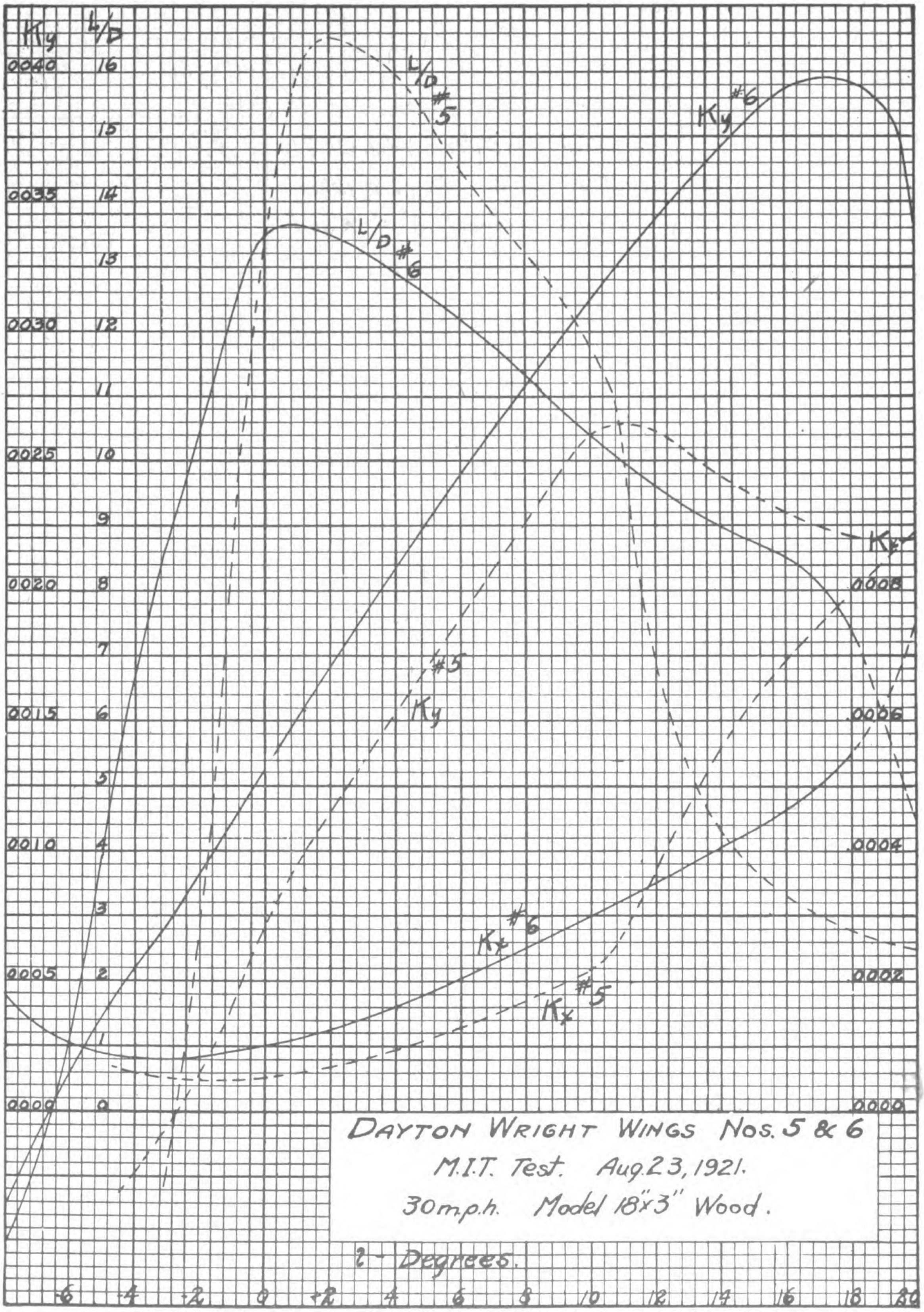

GÖTTINGEN No. 387.
M.I.T. Test. Aug. 22, 1921.
30 m.p.h. Model 18"x3" Wood.
MOMENT ABOUT LEADING EDGE
M - in. lbs.
i - Degrees.
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
1.3
-8
-6
-4
-2
0
+2
4
6
8
10
12
14
16
18

FIG. 3.



Ky
L/D
L/D #5
L/D #6
Ky #6
Ky #5
Kx
Kx #6
Kx #5
DAYTON WRIGHT WINGS NOS. 5 & 6
M.I.T. Test. Aug. 23, 1921.
30 m.p.h. Model 18" x 3" Wood.
i - Degrees.

FIG. 4.

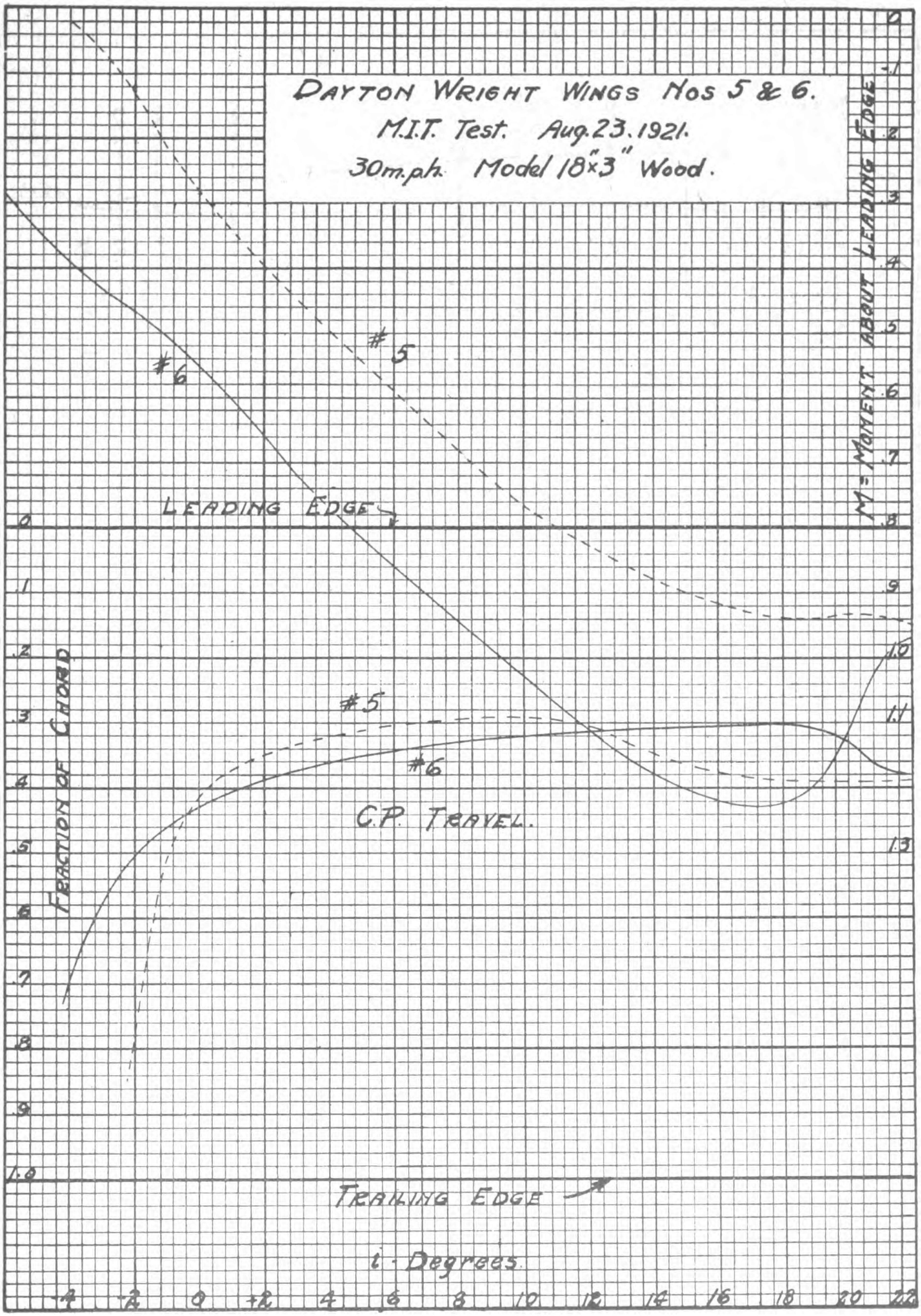

DAYTON WRIGHT WINGS NOS 5 & 6.
M.I.T. Test. Aug. 23. 1921.
30 m.p.h. Model 18"×3" Wood.
#5
#6
LEADING EDGE
#5
#6
C.P. TRAVEL.
FRACTION OF CHORD
M = MOMENT ABOUT LEADING EDGE
TRAILING EDGE
i - Degrees
-4
-2
0
+2
4
6
8
10
12
14
16
18
20
22
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.3

FIG. 5.

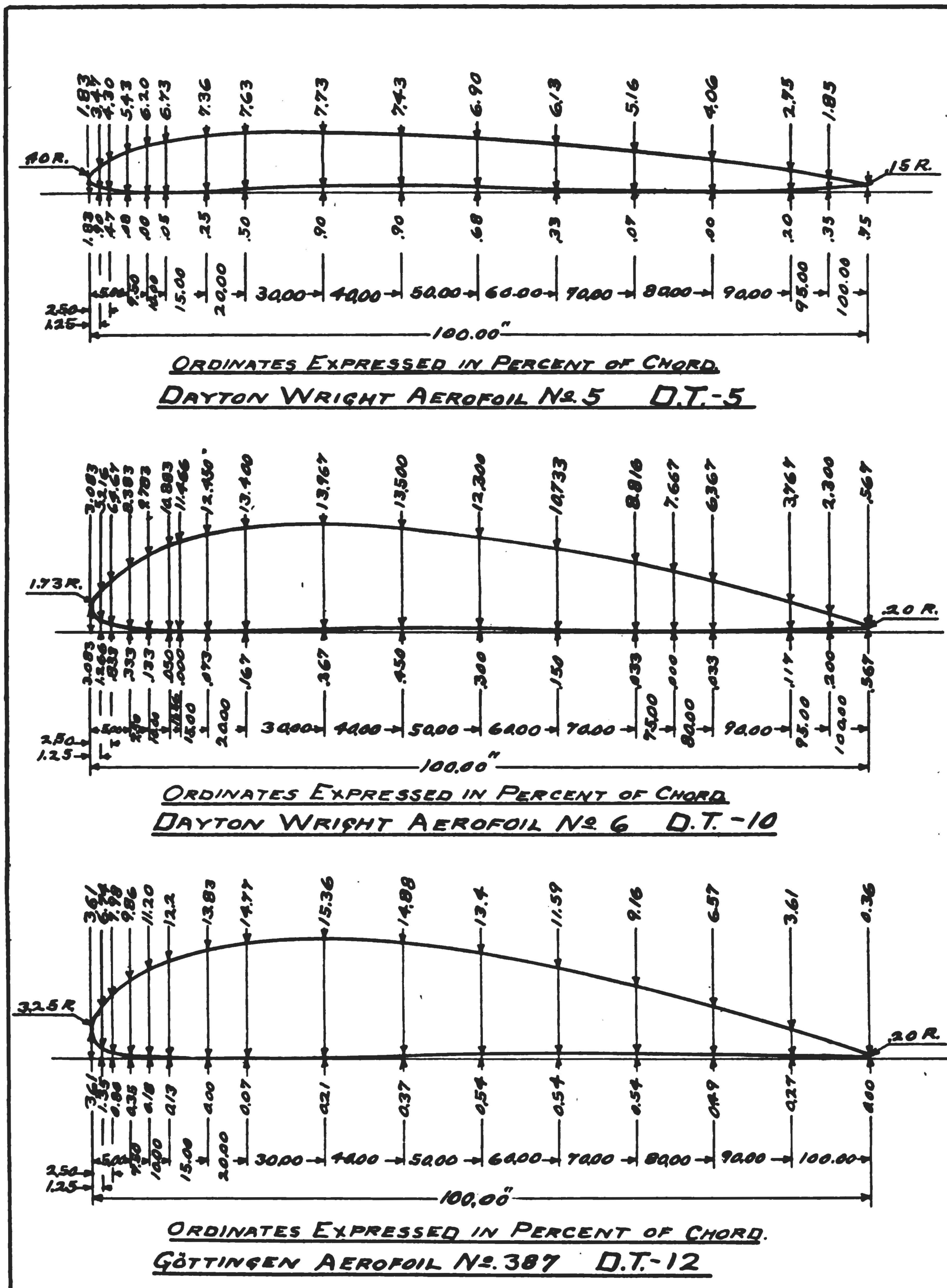

ORDINATES EXPRESSED IN PERCENT OF CHORD.
DAYTON WRIGHT AEROFOIL No. 5 D.T.-5
ORDINATES EXPRESSED IN PERCENT OF CHORD.
DAYTON WRIGHT AEROFOIL No. 6 D.T.-10
ORDINATES EXPRESSED IN PERCENT OF CHORD.
GÖTTINGEN AEROFOIL No. 387 D.T.-12

FIG. 6.

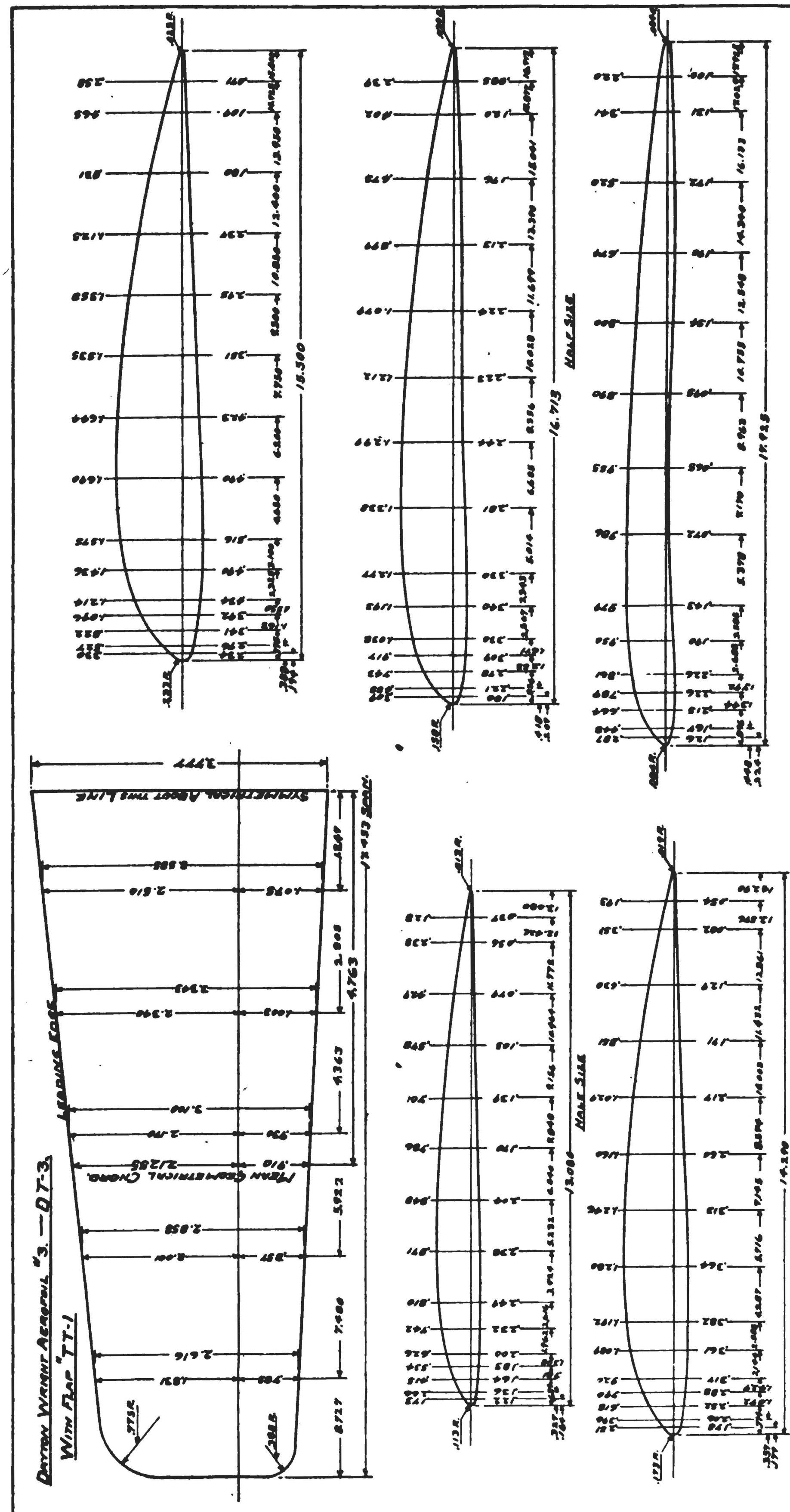

DAYTON WRIGHT AEROFOIL #3. —DT-3.
WITH FLAP "TT-1"
LEADING EDGE
MEAN GEOMETRICAL CHORD
SYMMETRICAL ABOUT THIS LINE
HALF SIZE
HALF SIZE

FIG. 7.

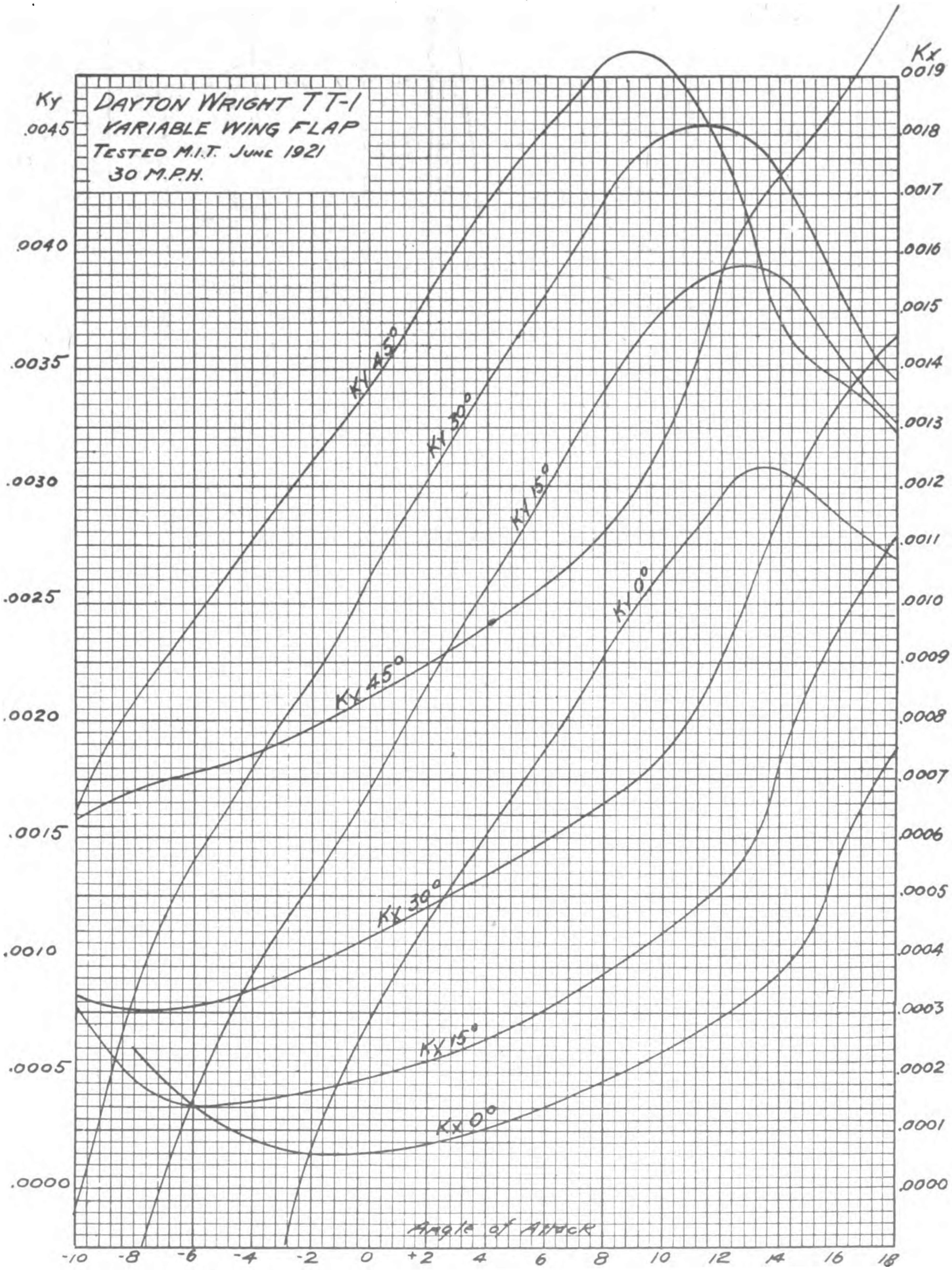

DAYTON WRIGHT T T-1
VARIABLE WING FLAP
TESTED M.I.T. JUNE 1921
30 M.P.H.
Ky
Kx
Ky 45°
Ky 30°
Ky 15°
Ky 0°
Kx 45°
Kx 30°
Kx 15°
Kx 0°
Angle of Attack
.0045
.0040
.0035
.0030
.0025
.0020
.0015
.0010
.0005
.0000
.0019
.0018
.0017
.0016
.0015
.0014
.0013
.0012
.0011
.0010
.0009
.0008
.0007
.0006
.0005
.0004
.0003
.0002
.0001
.0000
-10
-8
-6
-4
-2
0
+2
4
6
8
10
12
14
16
18

FIG. 8.

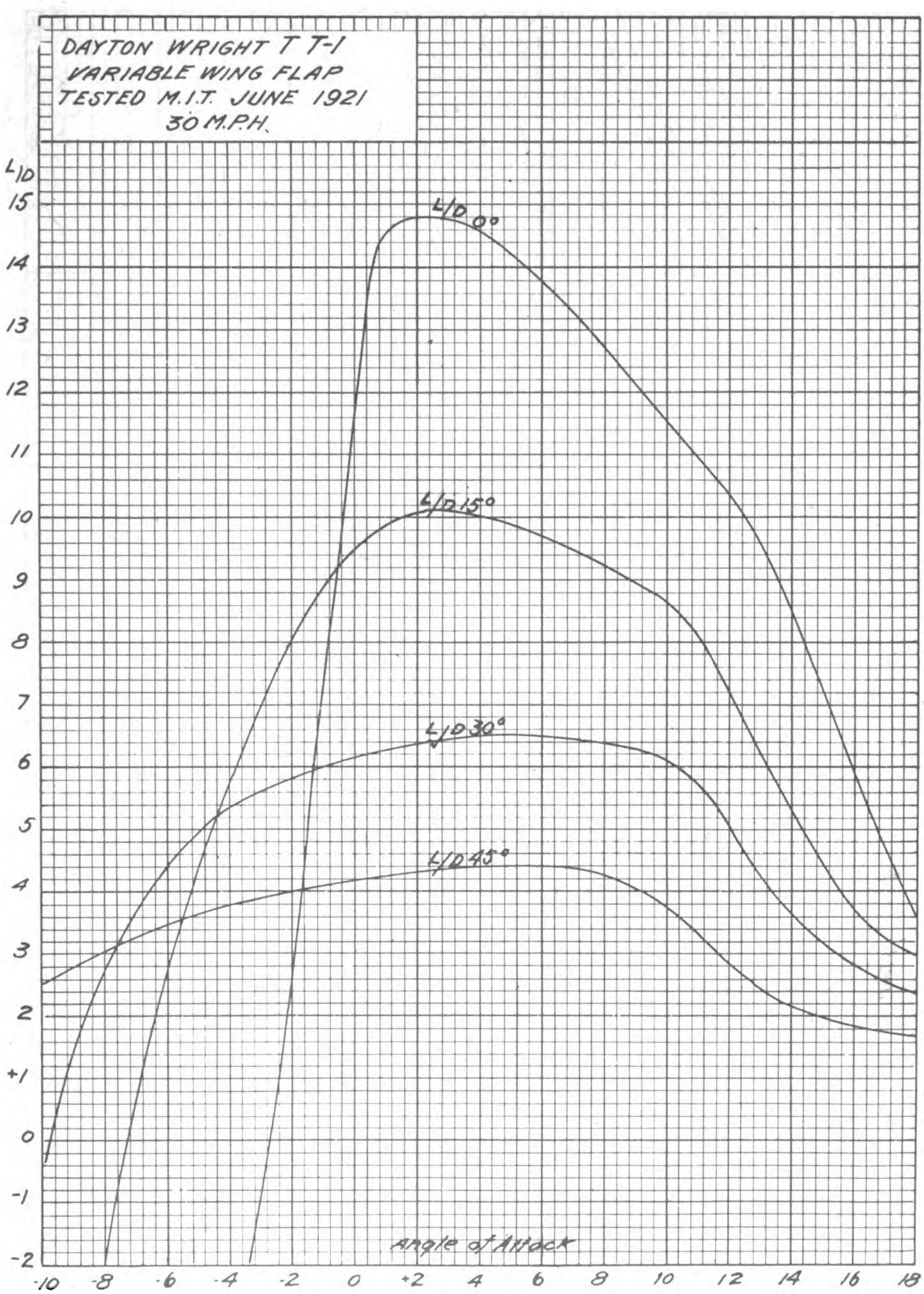

DAYTON WRIGHT T T-1
VARIABLE WING FLAP
TESTED M.I.T. JUNE 1921
30 M.P.H.
L/D
L/D 0°
L/D 15°
L/D 30°
L/D 45°
Angle of Attack
15
14
13
12
11
10
9
8
7
6
5
4
3
2
+1
0
-1
-2
-10
-8
-6
-4
-2
0
+2
4
6
8
10
12
14
16
18

FIG. 9.

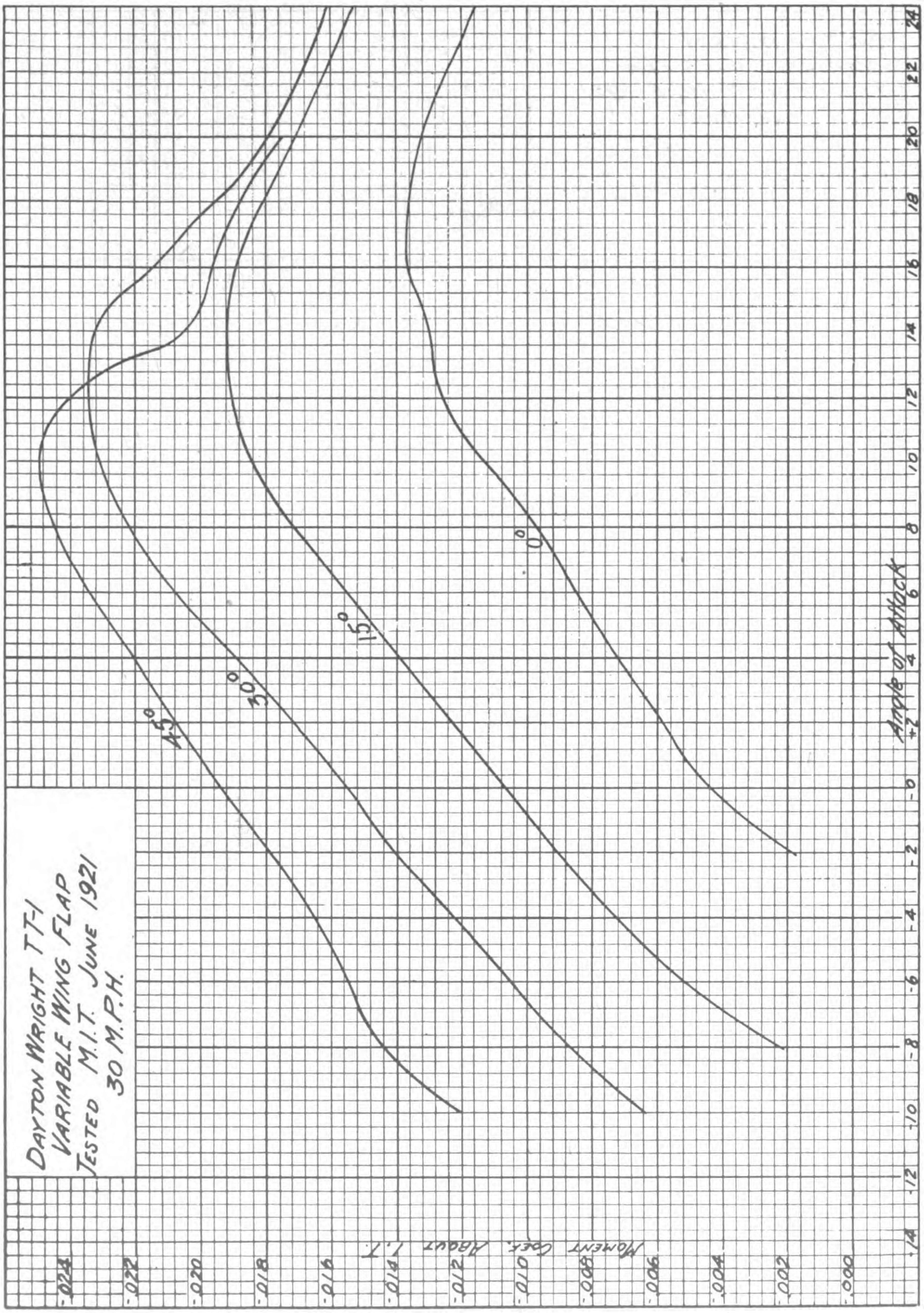

DAYTON WRIGHT TT-1
VARIABLE WING FLAP
TESTED M.I.T. JUNE 1921
30 M.P.H.
MOMENT COEF. ABOUT L.T.
Angle of Attack
45°
30°
15°
0°

FIG. 10.

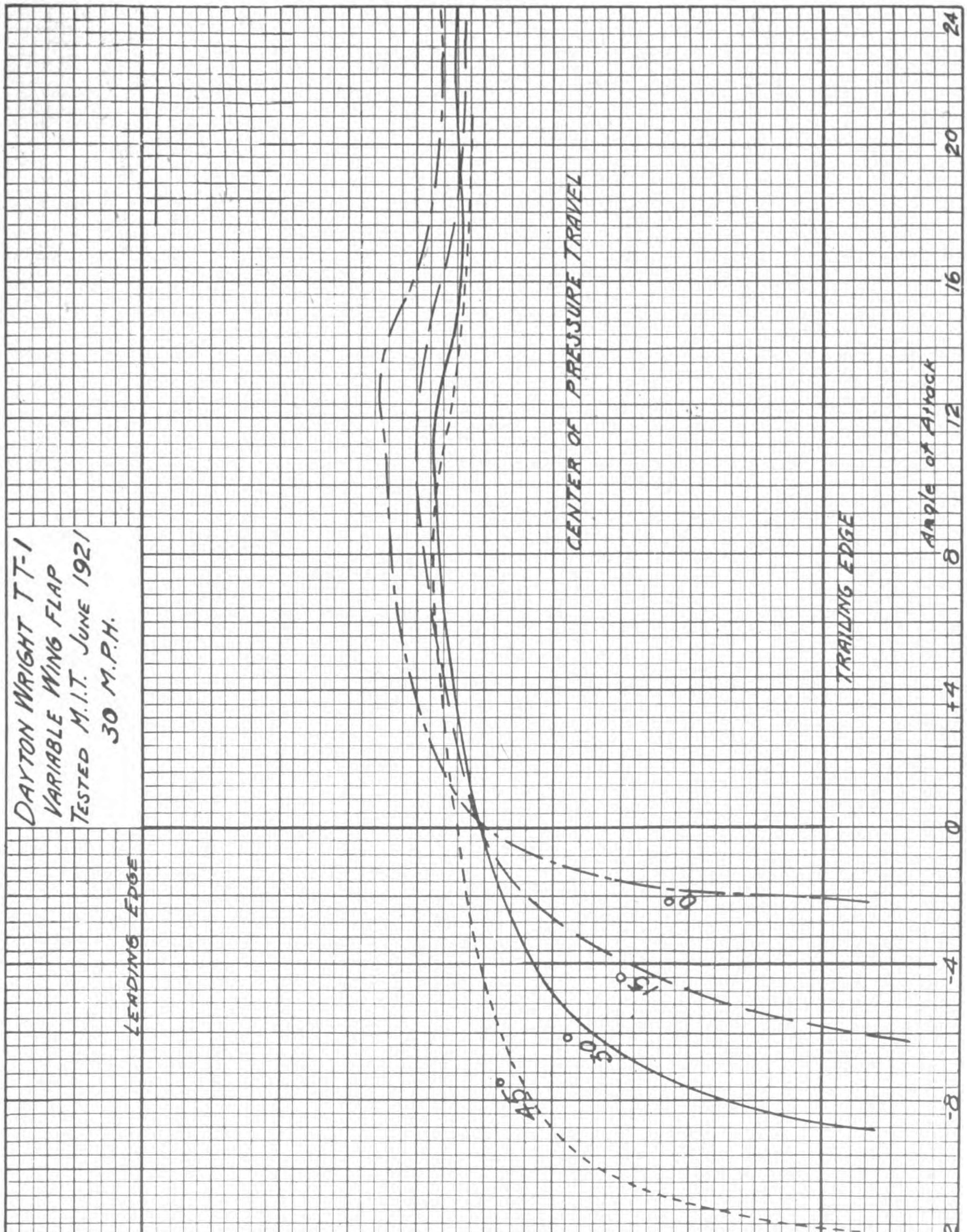

DAYTON WRIGHT TT-1
VARIABLE WING FLAP
TESTED M.I.T. JUNE 1921
30 M.P.H.
CENTER OF PRESSURE TRAVEL
LEADING EDGE
TRAILING EDGE
Angle of Attack
24
20
16
12
8
+4
0
-4
-8
-12
FRACTION OF CHORD
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
45°
30°
15°
0°

FIG. 11.

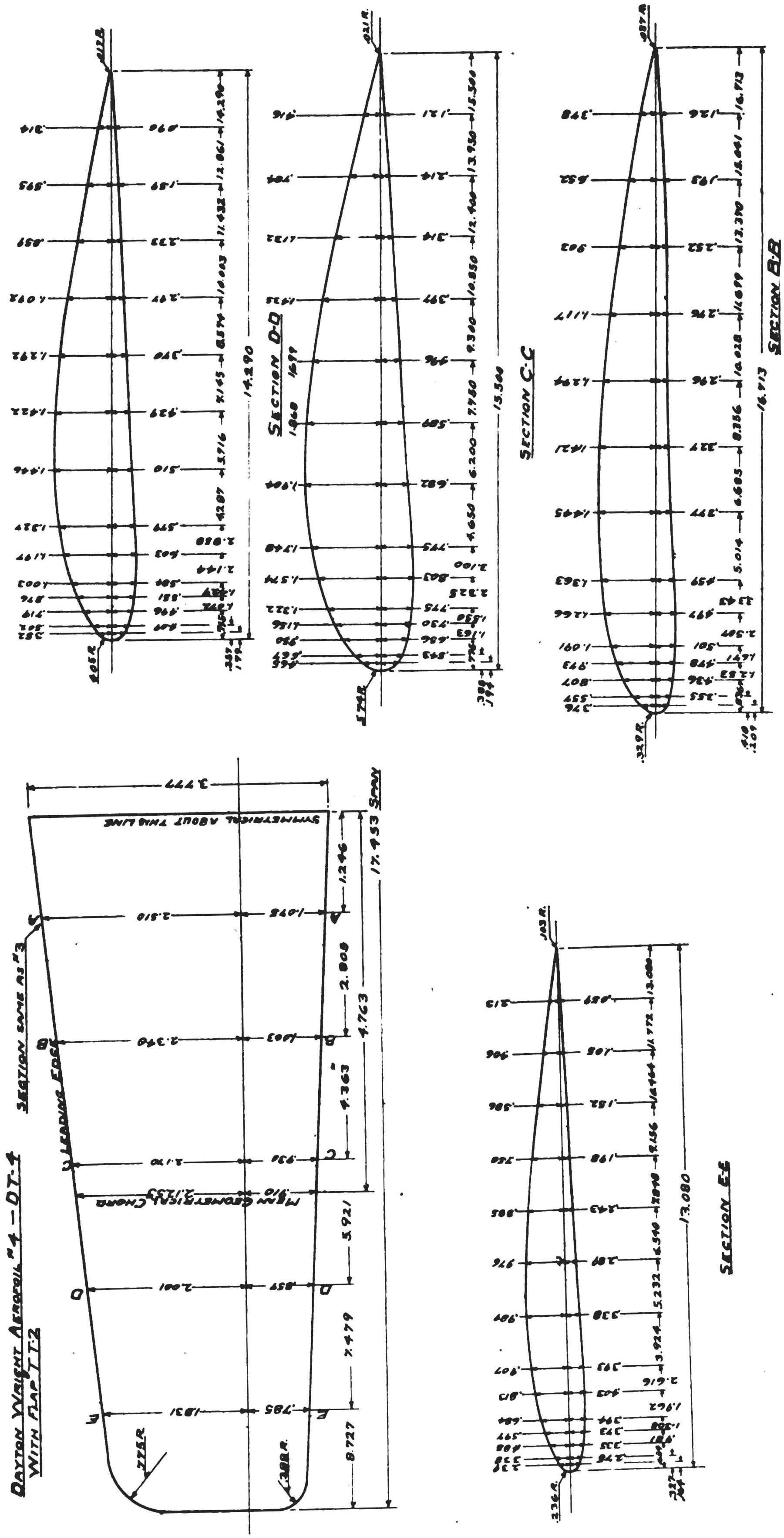

DAYTON WRIGHT AEROFOIL #4 — DT-4
WITH FLAP T.T.2
SECTION SAME AS #3
LEADING EDGE
SYMMETRICAL ABOUT THIS LINE
MEAN GEOMETRICAL CHORD
17.453 SPAN
SECTION B-B
SECTION C-C
SECTION D-D
SECTION E-E

FIG. 12.

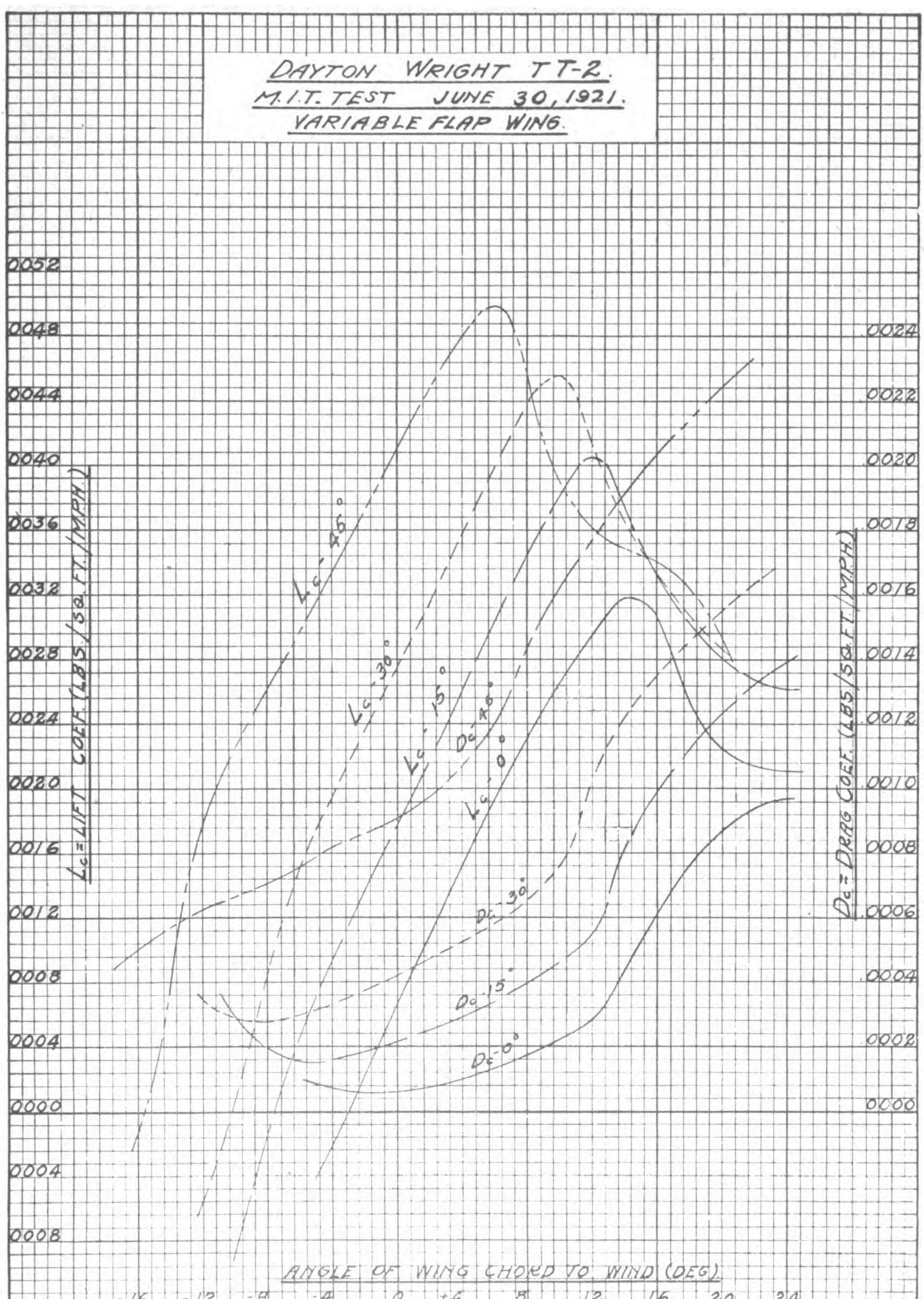

DAYTON WRIGHT TT-2.
M.I.T. TEST JUNE 30, 1921.
VARIABLE FLAP WING.
Lc = LIFT COEF. (LBS./SQ.FT./MPH.)
Dc = DRAG COEF. (LBS./SQ.FT./MPH.)
Lc-45°
Lc-30°
Lc-15°
Lc-0°
Dc-45°
Dc-30°
Dc-15°
Dc-0°
ANGLE OF WING CHORD TO WIND (DEG.)
.0052
.0048
.0044
.0040
.0036
.0032
.0028
.0024
.0020
.0016
.0012
.0008
.0004
.0000
.0004
.0008
.0024
.0022
.0020
.0018
.0016
.0014
.0012
.0010
.0008
.0006
.0004
.0002
.0000
-16
-12
-8
-4
0
+4
8
12
16
20
24

FIG. 13.

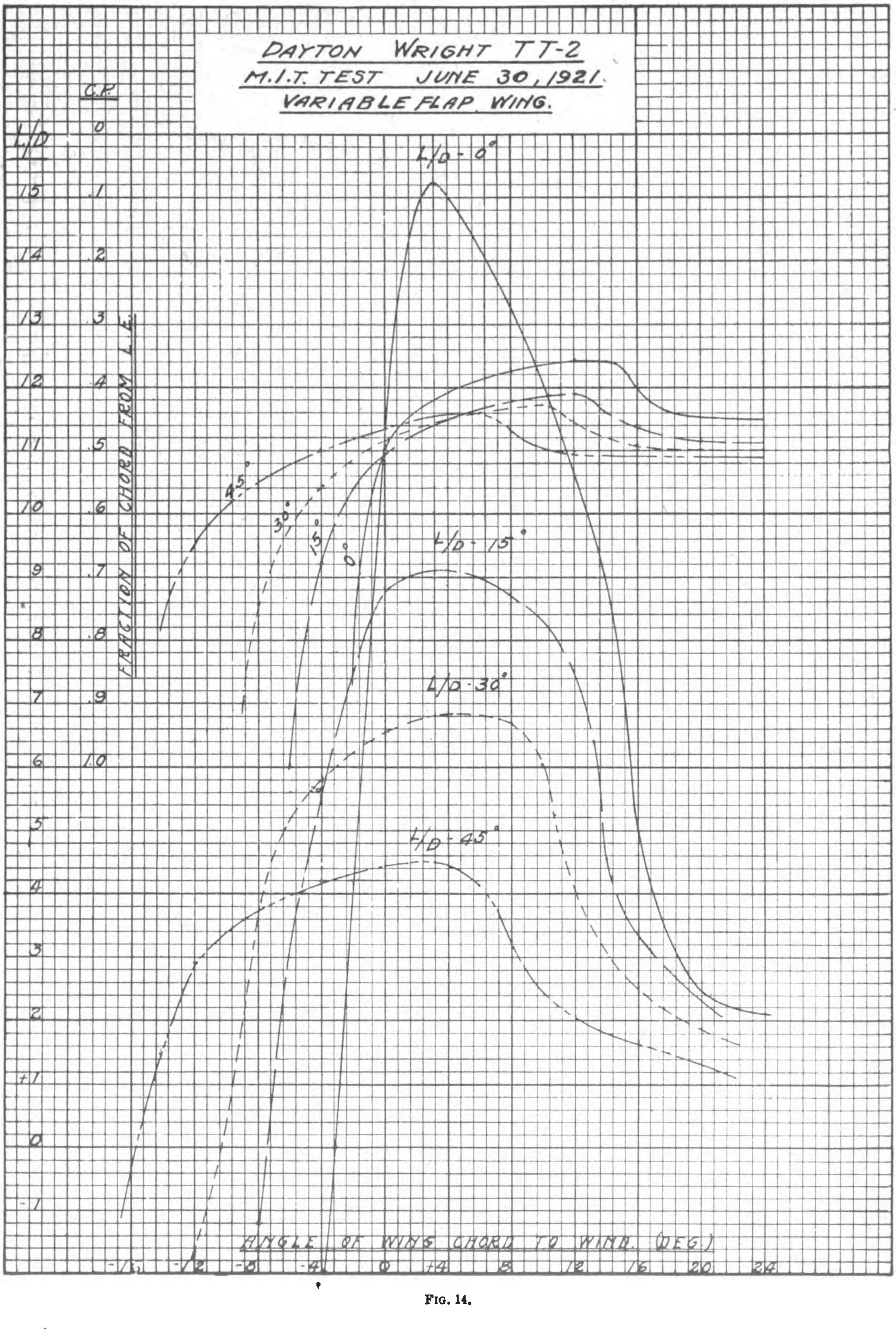

DAYTON WRIGHT TT-2
M.I.T. TEST JUNE 30, 1921.
VARIABLE FLAP WING.
C.P.
L/D
FRACTION OF CHORD FROM L.E.
L/D - 0°
L/D - 15°
L/D - 30°
L/D - 45°
45°
30°
15°
0°
ANGLE OF WING CHORD TO WIND (DEG.)

FIG. 14.

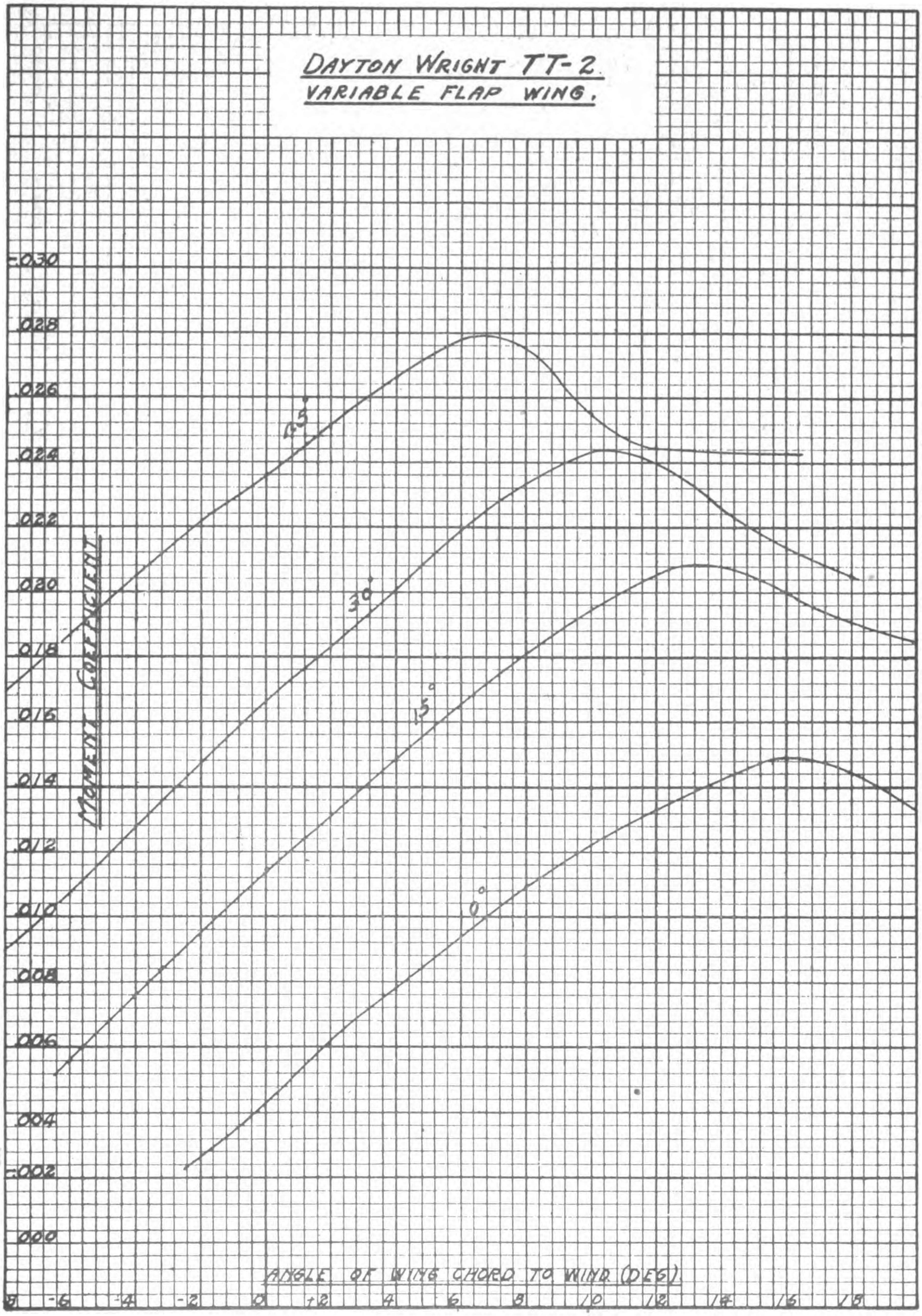
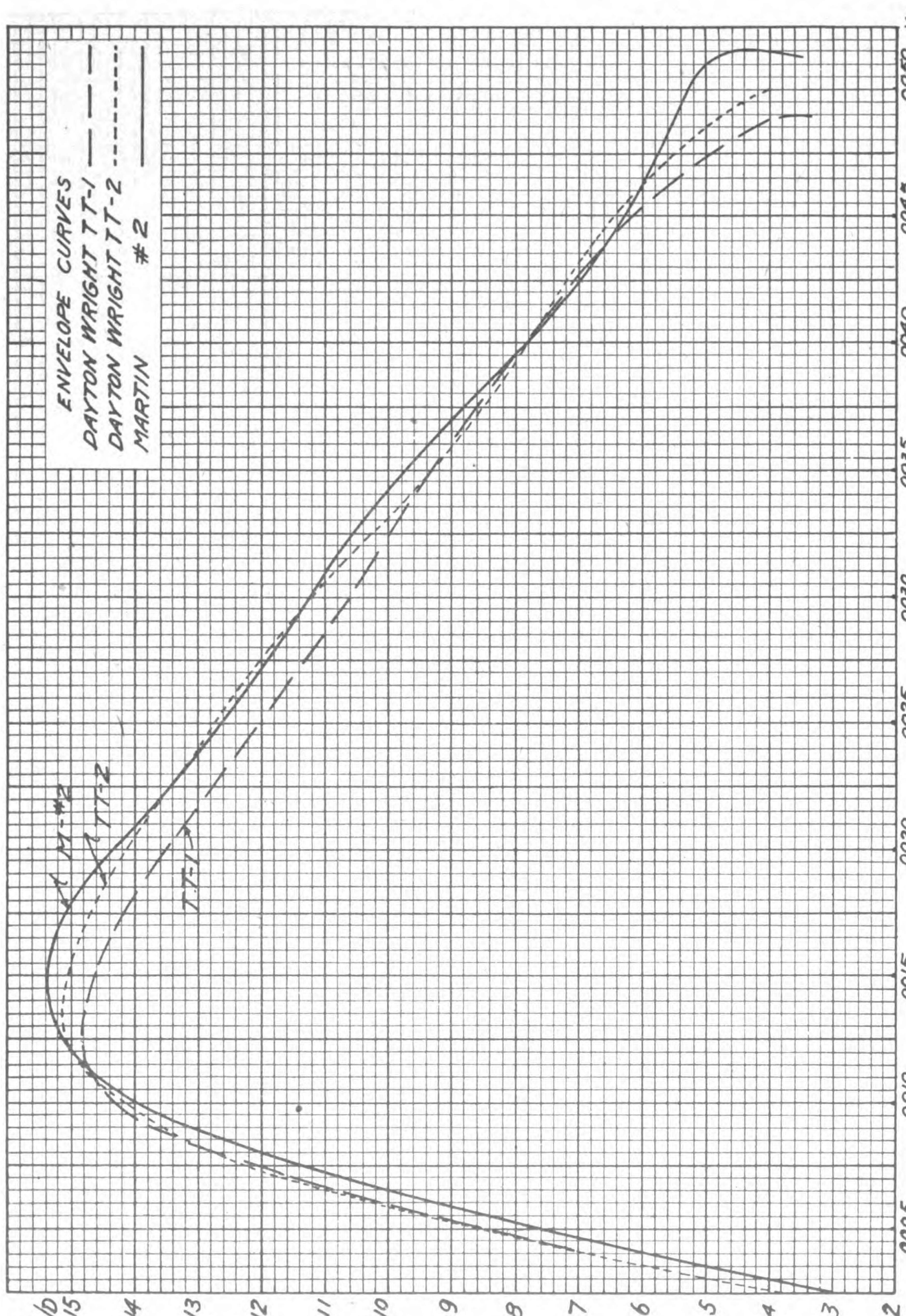
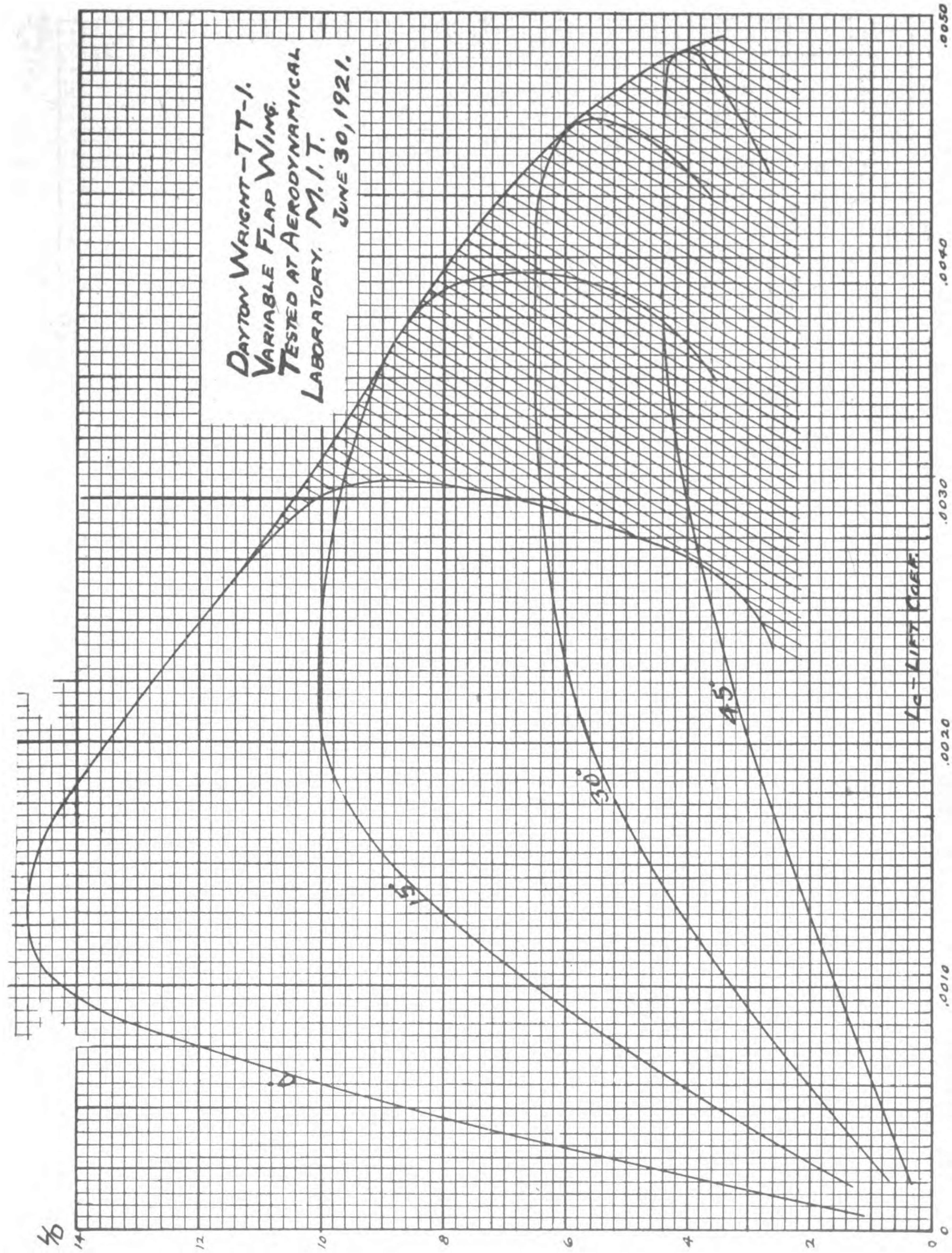

DAYTON WRIGHT TT-2
VARIABLE FLAP WING.
MOMENT COEFFICIENT
ANGLE OF WING CHORD TO WIND (DEG).
.030
.028
.026
.024
.022
.020
.018
.016
.014
.012
.010
.008
.006
.004
.002
.000
-6
-4
-2
0
+2
4
6
8
10
12
14
16
18
45°
30°
15°
0°

FIG. 15.



ENVELOPE CURVES
DAYTON WRIGHT TT-1
DAYTON WRIGHT TT-2
MARTIN #2
L/D
Ky
M-#2
TT-2
TT-1
15
14
13
12
11
10
9
8
7
6
5
4
3
2
.0005
.0010
.0015
.0020
.0025
.0030
.0035
.0040
.0045
.0050

FIG. 16.



DAYTON WRIGHT-TT-1.
VARIABLE FLAP WING.
TESTED AT AERODYNAMICAL
LABORATORY. M.I.T.
JUNE 30, 1921.
L/D
LC - LIFT COEF.
0°
15°
30°
45°
14
12
10
8
6
4
2
0
.0010
.0020
.0030
.0040
.0050

Fig. 17.

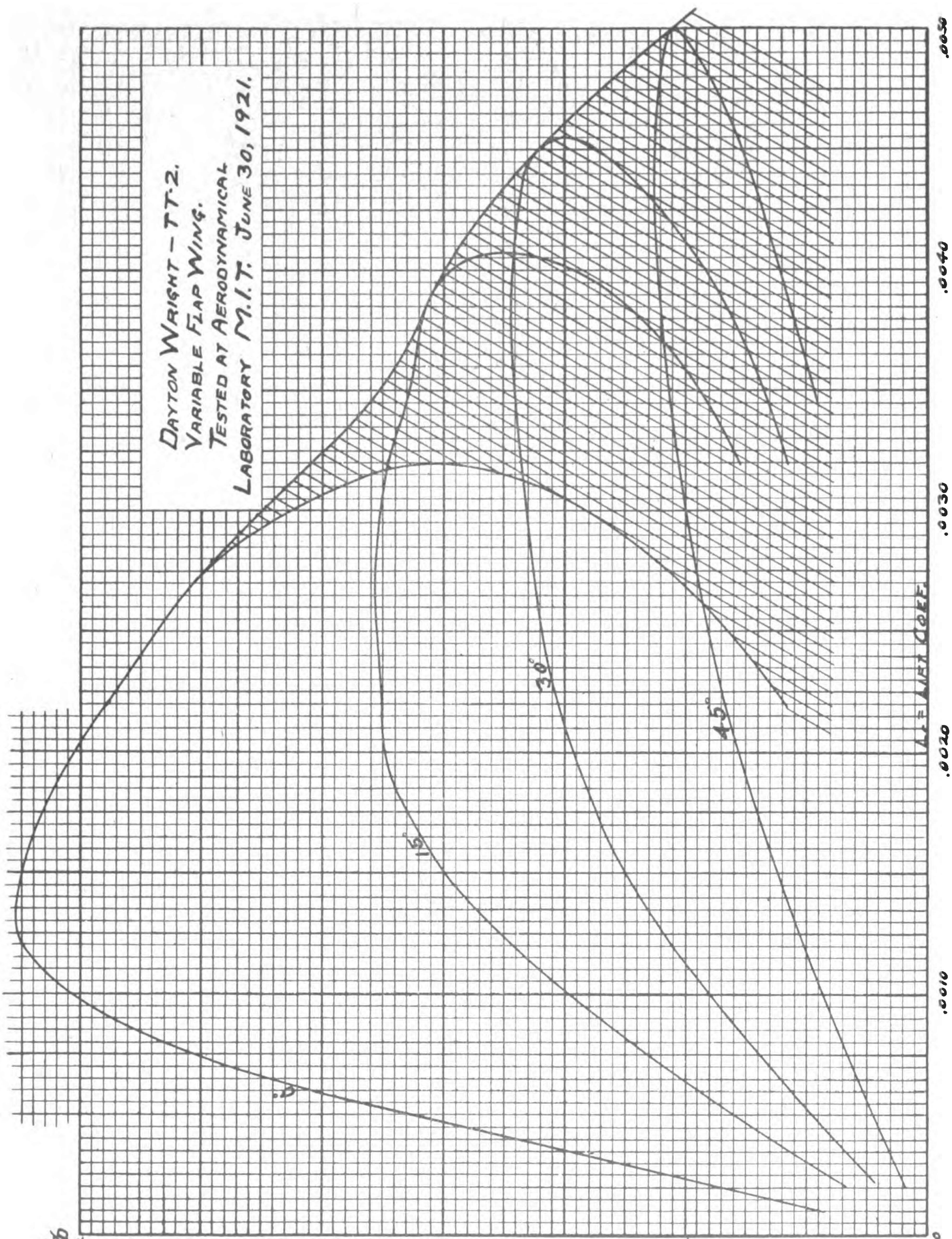

DAYTON WRIGHT - T.T-2.
VARIABLE FLAP WING.
TESTED AT AERODYNAMICAL
LABORATORY M.I.T. JUNE 30, 1921.
L/D
14
12
10
8
6
4
2
0
.0010
.0020
.0030
.0040
.0050
L = LIFT COEF.
0°
15°
30°
45°

FIG. 18.